THAT this will be the effect of the machine, I can atteſt, having uſed it for more than a year.

IT is ſubmitted to the curious, whether this machine might not be uſefully applied, 1ſt, to regulate the heat of chymical and alchymical furnaces, where long digeſtions, and a uniform degree of heat are required; 2dly, in the making of ſteel, and in burning of Porcelain ware, in which a due regulation of the fire is of great importance; 3dly, in green or hot houſes, and in apartments for hatching chickens, according to the Egyptian method. With a little alteration it might be applied to the purpoſe of opening doors, windows, and other paſſages, for a draught of air, and thereby preſerve a due temperature of the air in hoſpitals, &c.

An Account of a MACHINE *for pumping Veſſels at Sea, without the Labour of Men.*

By RICHARD WELLS.

IN the courſe of the immenſe trade now purſued on the ocean, veſſels are continually ſubject to leaks, which too often prove fatal to the crews, who, wearied out with inceſſant pumping, are obliged, at laſt, to ſubmit to their unhappy fate, and deſponding ſink into their watery graves. It is therefore much to be deſired, that ſome method could be ſuggeſted for preſerving the lives of ſo intrepid and uſeful a ſet of men. What has occurred to me on this ſubject, I beg leave to lay before the Society, and flatter myſelf, it will not prove altogether unworthy of notice.

WHEN a veſſel ſprings a leak at ſea, which cannot be diſcovered, inſtead of exhauſting the crew with continual working at the pumps, they may form, with very little trouble, a machine to diſcharge the water, which will work itſelf, without any aſſiſtance from the hands on board.

LET a ſpar or ſpare top-maſt be cut to the length of eight or ten feet, or more, according to the ſize of the veſſel; mortice four

four holes through the thickeſt end, through which run four oars, fixing them tight, exactly in the middle; to the four handles of the oars nail on four blades (made of ſtaves) the ſize of the other ends, which will form a very good water wheel, if the oars are ſtrong; then fix into the oppoſite end, what is commonly called a crank; the iron handle of a grindſtone would ſuit extremely well; if not to be had, any ſtrong bar of iron may be bent into that form, wedging it tight, to prevent its twiſting round: then nail up a new pair of chaps on the fore part of the pump, for a new nandle to be fixed in, which will point with its outer end to the bow of the veſſel; this handle will be ſhort on the outſide, but as long on the inſide as the diameter of the bore of the pump will admit, in order that the ſpear may be plunged the deeper, and of courſe make the longer ſtroke; the handle muſt be large enough to have a ſlit ſawed up it, ſufficient to admit a ſtave edge ways, which muſt be faſtened with a ſtrong or iron pin, on which it may work; the lower end of the ſtave muſt be bored, to admit the round end of the crank; then fix the ſhaft with the oars (or arms) over the gunwale on two crotches, one ſpiked to the gunwale, and the other near the pump, cutting in the ſhaft a circular notch, as well to make it run eaſier, by leſſening the friction, as to keep the whole ſteady. A bolt muſt be fixed in each crotch, cloſe over the ſhaft, to keep it from riſing; as ſoon as the wheel touches the water, it will turn round, and the crank, by means of the ſtave fixed on its end, will work the handle of the pump. If the bore be four inches, and the piſton or ſpear moves eighteen inches at a ſtroke, it will diſcharge 220 cubic inches of water, and admitting the arms of a wheel to be ſix feet from the center, it will turn round about 146 times in a mile, or 730 times in an hour, when the ſhip ſails five knots, which is equal to nine hogſheads. If the ſurface of the water in the whole be fifteen feet from the nozle of the pump, a man can raiſe in an hour, with common working, about thirty-eight hogſheads, which far exceeds the work performed by the wheel; but this calculation is made on pumps of the common ſize, I would therefore propoſe that all veſſels ſhould carry larger pumps, the advantage of which will appear from the following table.

A 4 inch bore will diſcharge per hour, ſailing at the rate of
five knots, - - - 9 hogſheads
5 inch, - - - - 14 and an half.
6 ditto, - - - - 20 and 3-4ths.
7 ditto, - - - - 28 and 1-4th.
8 ditto, - - - - 37 hogſheads.

HENCE we find, that a pump of eight inches bore, will diſcharge with the wheel nearly the ſame quantity that a man commonly raiſes. If both pumps be ſet to work by the crank, double the quantity, or 74 hogheads will be diſcharged; but if a cog wheel, of about three feet ten inches, with 51 cogs, be fixed on the end of the ſhaft or axis, and the crank be paſſed through a trundle or lanthorn wheel, of about two feet diameter, with thirteen rounds, to work with the axis parallel to the deck, and fixed to the pumps, in the manner uſed by brewers and diſtillers, the crank will make about four turns to one revolution of the great wheel, and of courſe deliver 296 hogſheads per hour; yet as the reſiſtance made by the pumps will, in ſome meaſure, impede the motion of the wheel, it will not turn at the rate of 730 times in an hour, for which ſuppoſe a deduction of one-third, which is certainly a great allowance, the quantity then diſcharged per hour is about 200 hogſheads, which is more than equal to the conſtant work of five men; thus if a veſſel ſailing at the rate of

5 Knots, delivers 200 hogſheads per hour, equal to five mens work.
6 Knots is 240 - - - equal to 6 ditto.
7 Knots 280 - - - equal to 7 ditto.
8 Knots 320 - - - equal to 8 mens work.

I AM aware of many objections that will be ſuggeſted. In the firſt place it will be ſaid, that pumps of eight inches bore, will be too large to be worked by the ſtrength of men, when the wheel cannot be applied. I anſwer, no more force is required to diſcharge a gallon of water at a ſtroke from an eight inch, than from a four inch bore; as the ſhort end of the lever or handle to the eight inch bore, need not be above a quarter part the length of the four inch, which will give a purchaſe to the ſailor at the long end of the lever, ſufficient to raiſe the piſton

piſton or ſpear a quarter the heighth of what is required in a four inch bore for a piſton moving three inches in an eight inch bore, and twelve inches in a four inch bore, will deliver juſt about the ſame quantity of water. It will be further objected, that in ſtormy weather, when veſſels generally make the moſt water, the wheel could not be put overboard. I own there is ſome force in this objection, but if a remedy is beneficial in ſome caſes, though not adequate in all, it ought not to be totally rejected. Many leaks happen at ſea in moderate weather, and even thoſe which are occaſioned by damage in a ſtorm, often continue when the waves are abated. Sailors are frequently unhappily waſhed overboard, and poſſibly thoſe who may have ſurvived the ſtorm, are too few, and too weak, to keep the ſhip clear of water, and perform the other neceſſary duties on board, in ſuch caſes this machine would be evidently uſeful. It may alſo be urged, that the wind at ſuch time may be ſo much a head, that the ſhip cannot make way enough through the water to work the pumps; to which I reply, when life is in danger, when grim death ſtares the affrighted crew in the face, the port of deſtination is not to be conſidered, but the veſſel muſt be ſteered for that ſhore, which beſt ſuits the working of the pumps, and keeping her above water.

I WOULD therefore propoſe, that every veſſel ſhould not only have pumps of eight inches bore, but be provided with a ſhaft, crank, and proper wheels, which might eaſily be ſtowed away in little room, as the paddles of the water wheel may be unſhipped, and the whole procured at a ſmall expence.

THESE hints, together with the model, I ſubmit to the inſpection of the Society, and hope ſome improvement may be made on this plan, which will prove uſeful to mankind.

REFERENCES. Plate VI. *fig.* II.

A. Top-Maſt or Shaft of the Wheel. B. Oars or Arms of the Wheel. C. Crank. D. Pump. E. Props on the Deck, to ſupport the Shaft.